[0135] The recombinant cloning vector, according to this disclosure, then comprises the selected DNA of the DNA sequences of this disclosure for expression in a suitable host. The DNA is operatively linked in the vector to an expression control sequence in the recombinant DNA molecule so that the actin polypeptide can be expressed. The expression control sequence may be selected from the group consisting of sequences that control the expression of genes of prokaryotic or eukaryotic cells and their viruses and combinations thereof. The expression control sequence may be specifically selected from the group consisting of the lac system, the trp system, the tac system, the trc system, major operator and promoter regions of phage lambda, the control region of fd coat protein, the early and late promoters of SV40, promoters derived from polyoma, adenovirus, retrovirus, baculovirus and simian virus, the promoter for 3-phosphoglycerate kinase, the promoters of yeast acid phosphatase, the promoter of the yeast alpha-mating factors and combinations thereof.

EXAMPLE 5

Motor Protein Variants

[0136] Variants of the motor proteins (such as actin and myosin) can be used instead of the native proteins, as long as the variants retain the motor activity. DNA mutagenesis techniques may be used to produce variant DNA molecules, and will facilitate the production of proteins which differ in certain structural aspects from the native protein, yet the variant proteins are clearly derivative and maintain the essential functional characteristic of the motor protein as defined above. Newly derived proteins may also be selected in order to obtain variations in the characteristics of the motor protein, as will be more fully described below. Such derivatives include those with variations in the amino acid sequence including minor deletions, additions and substitutions.

[0137] While the site for introducing an amino acid sequence variation is predetermined, the mutation per se need not be predetermined. For example, in order to optimize the performance of a mutation at a given site, random mutagenesis may be conducted at a target codon or region and the expressed protein variants screened for optimal activity. Techniques for making substitution mutations at predetermined sites in DNA having a known sequence are well known.

[0138] Amino acid substitutions are typically of single residues, for example 1, 2, 3, 4 or more substitutions; insertions usually will be on the order of about from 1 to 10 amino acid residues; and deletions will range about from 1 to 30 residues. Substitutions, deletions, insertions or any combination thereof may be combined to arrive at a final construct. Obviously, the mutations that are made in the DNA encoding the protein must not place the sequence out of reading frame, and preferably will not create complementary regions that could produce secondary changes in the mRNA structure.

[0139] Substitutional variants are those in which at least one residue in the amino acid sequence has been removed and a different residue inserted in its place. Such substitutions are generally conservative substitutions when it is desired to finely modulate the characteristics of the protein. Examples of such conservative substitutions are well known, and are shown, for example, in U.S. Pat. No. 5,928,896 and U.S. Pat. No. 5,917,019.

[0140] Substantial changes in function or immunological identity are made by selecting substitutions that are less conservative i.e., selecting residues that differ more significantly in their effect on maintaining (a) the structure of the polypeptide backbone in the area of the substitution, for example, as a sheet or helical conformation, (b) the charge or hydrophobicity of the molecule at the target site, or (c) the bulk of the side chain. The substitutions which in general are expected to produce the greatest changes in protein properties will be those in which (a) a hydrophilic residue, e.g., seryl or threonyl, is substituted for (or by) a hydrophobic residue, e.g., leucyl, isoleucyl, phenylalanyl, valyl or alanyl; (b) a cysteine or proline is substituted for (or by) any other residue; (c) a residue having an electropositive side chain, e.g., lysyl, arginyl, or histadyl, is substituted for (or by) an electronegative residue, e.g., glutamyl or aspartyl; or (d) a residue having a bulky side chain, e.g., phenylalanine, is substituted for (or by) one not having a side chain, e.g., glycine.

EXAMPLE 6

[0141] An embodiment of a molecular motor **310** that includes annular substrates is depicted in **FIG. 10**. Discs are shown as the annular substrates in **FIG. 10**, but a layer of concentric rings lying in a common plane may be substituted for each one of the discs. These rings and ring layers are shown in detail in **FIG. 13**.

[0142] With reference to **FIG. 10, a** planar surface of a first disc **311** is secured to a base **312** so that the first disc **311** is not free to rotate relative to the base **312**. The first disc **311** may be secured to the base **312** by any suitable manner such as by an adhesive. A second disc **313** is secured to a drive member **314** so that the second disc **313** is free to rotate relative to the first disc **311**. The second disc **313** may be secured to the drive member **314** by any suitable manner such as by an adhesive. The drive member **314** may include a series of gear teeth for driving a driven member similar to that shown in **FIG. 1**. The first disc **311** and the second disc **313** are axially aligned relative to each other along a central longitudinal axis **320**. The first disc **311** and the second disc **313** each define a respective orifice (depicted, for example, as element **352** in **FIG. 12A** or as element **372** in **FIG. 12B**) centered on the central axis **320**. The orifices receive a support rod **319** that is axially aligned along the central axis **320**. The support rod **319** is secured by the base **312** so that the support rod **319** is not free to rotate relative to the base **312**. The support rod **319** is received within the drive member **314** so that the drive member **314** and second disc **313** remain free to rotate relative to the support rod **319**. Bushings or ball bearings (not shown) may be provided at the surface interfaces between the support rod **319** and the drive member **314**, and between the support rod **319** and the second disc **313** to allow the relative rotation. The support rod **319** assists in maintaining the radial alignment of the discs.

[0143] Myosin is coated on a planar surface **316** of the first disc **311** that is obverse to the disc surface secured to the base **312**. Actin is coated on a planar surface **317** of the second disc **313** that is obverse to the disc surface secured